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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 527

Contribution from the States Relations Service
A. C. TRUE, Director

Washington, D. C. PROFESSIONAL PAPER July 26, 1917

SOME EXERCISES IN FARM HANDICRAFT FOR RURAL SCHOOLS

By

H. O. SAMPSON, Assistant in Agricultural Education

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SOME EXERCISES IN FARM HANDICRAFT FOR RURAL ELEMENTARY SCHOOLS[1]

By H. O. SAMPSON, *Assistant in Agricultural Education.*

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INTRODUCTION.

The purpose of this bulletin is to give instruction in the making of useful articles for the school, farm, and home. It is intended primarily for rural school teachers and for pupils of the seventh and eighth grades. The exercises have practical application to the agricultural work of the school and also to the various club projects in agriculture. In some States farm mechanics, or as it is termed, handicraft work, is conducted as a regular club project and is proving to be desirable for this purpose.

Many of the exercises and drawings are compiled from extension bulletins of the different States. Bulletins published by Kansas and Iowa agricultural colleges have been used very freely. In these

[1] Prepared under the direction of C. H. Lane, Chief Specialist in Agricultural Education, States Relations Service.

NOTE.—This bulletin furnishes elementary lessons in farm mechanics and is of interest to teachers and pupils of rural schools in all parts of the United States.

States the handicraft club work has received considerable attention. Others of the exercises are from publications of this department; still others are original with the author, being those he has used in giving instruction in agriculture in public schools and in his work on the farm.

It is hoped that the exercises outlined will suggest many others. A large number of school, farm, and home appliances can be made by schoolboys, and the making of these things trains the hand and the eye and develops habits of accuracy and neatness. The work can be done as a part of the regular school work or during spare time at home. It will be a recreation as well as a benefit.

TOOLS AND THEIR USES.

A large investment in tools is not necessary to carry on this work, and many boys on farms will find all the necessary tools at home. For most of the woodworking exercises the following are sufficient: Crosscut saw, ripsaw, 2-foot rule, steel square, try square, hammer, jack plane, block plane, marking gauge, ¼-inch and ½-inch chisels, bits and brace, and screw driver. These tools will cost, if purchased new, approximately $11.

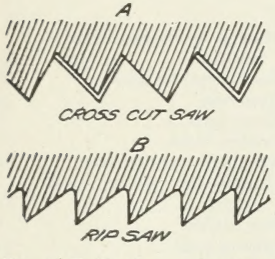


FIG. 1.—Teeth of crosscut and rip saws.

The tools should be of good quality; it seldom pays to purchase inferior ones. Carpenters when buying tools find it economy to select those bearing the stamp of a reliable manufacturer.

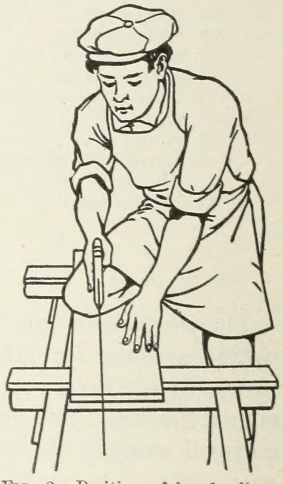


FIG. 2.—Position of hand, elbow, and shoulder, when using a saw.

All farm boys have had more or less experience with tools and know how to use them fairly well; nevertheless a brief mention of the uses of the tools given in the list will be of value.

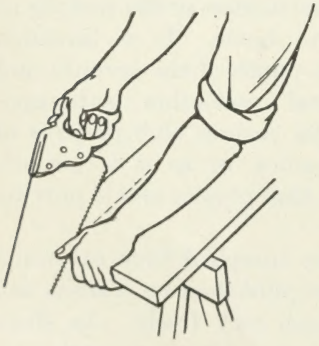


FIG. 3.—Starting the saw.

The crosscut saw, as the name indicates, is used to cut across the grain of the wood. Its teeth are filed to sharp points, as shown at *A*, figure 1. The teeth are usually set or bent alternately so as to be at a slight angle with the body of the saw blade. The insides of the

teeth are filed in sharpening, as indicated in the figure. The ripsaw is used to cut with the grain of the wood. Its teeth are filed to the shape of chisels placed one behind the other, as shown at *B*, figure 1.

Figure 2 shows the position of hand, elbow, and shoulder when using a saw. The index finger should be along the top of the handle on the right side and the thumb on the left side. They are then in a position to guide the saw. The hand, elbow, and shoulder should be in a straight line, as shown in the drawing. To start sawing, place the left hand on the mark on the board, as shown in figure 3, to guide the saw and make a light up stroke. Continue with a few light strokes up and down until the saw is well started and finally take full strokes the length of the blade.

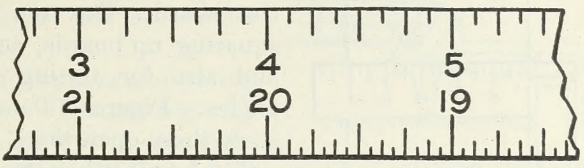


FIG. 4.—Divisions of a carpenter's rule.

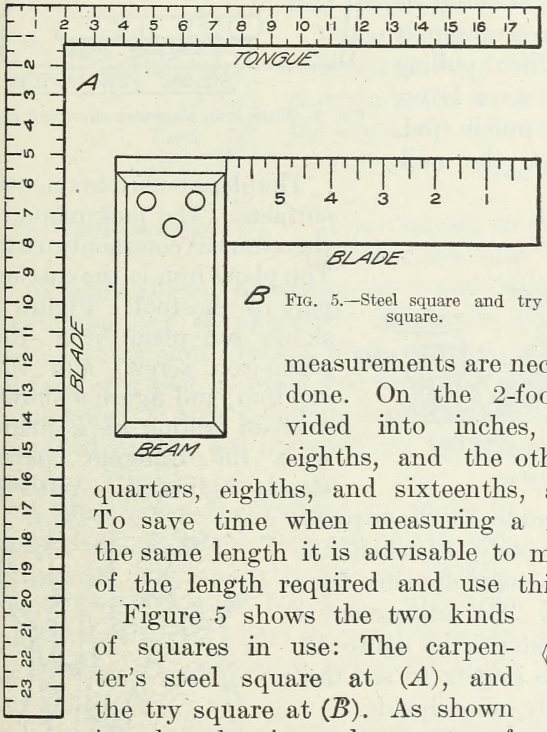


FIG. 5.—Steel square and try square.

The rule is the measuring gauge. Naturally, accurate measurements are necessary if good work is done. On the 2-foot rule one edge is divided into inches, halves, quarters, and eighths, and the other into inches, halves, quarters, eighths, and sixteenths, as shown in figure 4. To save time when measuring a number of pieces of the same length it is advisable to make a measuring stick of the length required and use this instead of the rule.

Figure 5 shows the two kinds of squares in use: The carpenter's steel square at (*A*), and the try square at (*B*). As shown in the drawing, the parts of a steel square are tongue and blade, and the parts of a try square are blade and beam. The carpenter's square is used for measuring lumber and also for squaring across boards when cutting stock into lengths. Figure 6 shows how a steel square is used for squaring across a board. Notice that the long side is parallel with the

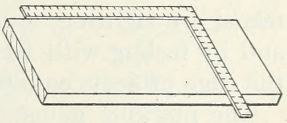


FIG. 6.—Squaring up a board with a steel square.

length of the board. As the square forms a right angle, the short side will then be at right angles to the sides of the board; consequently, a line drawn on the board along this short side will be at right angles to the side of the board. The try square is used for squaring up boards, as shown in figure 7, and also for testing surfaces and testing angles. Figures 15 and 16, pages 6 and 7, show these operations.

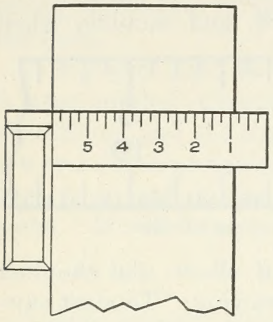


FIG. 7.—Squaring up a board with a try square.

The hammer has two uses—to drive nails, and to pull nails. When driving nails, grasp the handle near the end farthest from the head; you can strike a more effective blow than if you grasp it near the other end. When pulling nails, the hammer acts as a lever; it is surprising how much pulling force is exerted on the nail.

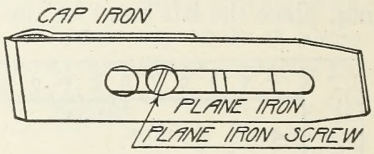


FIG. 8.—Plane iron, plane-iron screw, and cap iron.

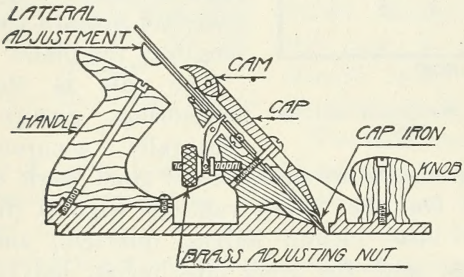


FIG. 9.—Parts of a plane.

The plane is used to smooth surfaces. The jack plane is the one most commonly used. The plane iron is the cutting part of the tool. Figure 8 shows the plane iron, the plane-iron screw, and the cap iron, and figure 9 shows a cross section of a plane with the different parts clearly indicated. With a plane before you, examine all these parts. When a plane is properly adjusted the plane iron projects the same distance from each side of the throat. The adjustment is tested by sighting, as shown in figure 10, and by feeling with the fingers to see that the edge projects equally on each side.

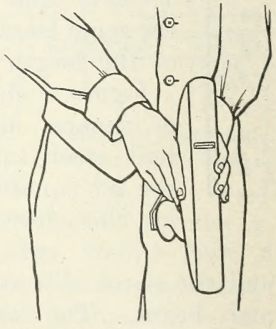


FIG. 10.—Sighting to adjust a plane.

The marking gauge is used to gauge, or mark, a line parallel to one edge of a board. To set the gauge, hold it point side up in the left hand, and with the rule in the right hand place the end of the rule against the gauge block and see that the measurement desired on the rule is at the point of the gauge, as shown in figure 11. Tighten the set screw, and the tool is ready for use.

To mark a line, hold the gauge firmly with the thumb and forefinger encircling the gauge block and tip the gauge away from you, as shown in figure 12. To make the line, push the tool—never pull it toward you. Do not press hard against the point—a line only as fine as a knife line is required.

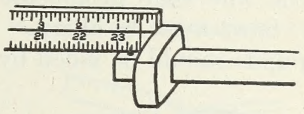


FIG. 11.—Setting the gauge.

The chisel is used in clipping and paring out portions of wood. When cutting with a chisel, grasp the handle with the right hand and the shank with the left hand and, instead of pushing straight down or straight ahead, incline the tool to get a paring action.

Figure 13 shows the parts of the brace and bit. Unless boring a slanting hole, the bit should enter the wood straight. If the side lips touch the wood at the same time you are sure that the bit has entered the wood straight.

When using a screw driver, be careful not to break the head off the screw. A little soap placed on the screw before inserting it into the wood will make it enter more easily.

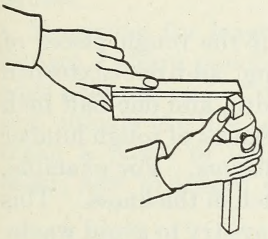


FIG. 12.—Method of using the gauge.

CARE OF TOOLS.

If you expect to do good work with tools you must see that they are well cared for. If tools are allowed to become rusty and dull and parts are lost good work can not be expected. Wipe the polished surfaces of tools with an oily cloth once a week, at least, and whenever the bright surface of a tool becomes wet wipe it dry and rub it well with the oily cloth. If rust accumulates, it can be removed by the use of powdered pumice stone.

A place must be provided in which to keep the tools when they are not in use, otherwise they may be lost or broken. Drawers in the work bench, or cupboards placed on the wall where they will be easily accessible, are convenient places for holding tools.

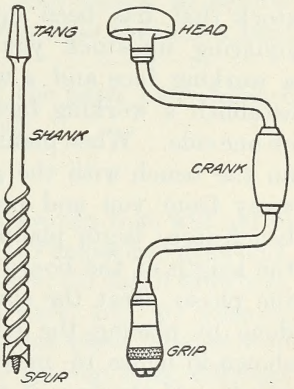


FIG. 13.—Brace and bit.

The cutting edges of tools must be kept sharp; good work can not be done with a dull tool. If chisels or plane irons become very dull, they are first sharpened on a grindstone or emery wheel, then dressed on an oilstone. They are ground at an angle of 25° and dressed on the oilstone at an angle of 30°, as shown in figure 14. If but slightly dull they may be rubbed up on the oilstone only. Hold them firmly on the grind-

stone or emery wheel, bevel side down, and grind until a thin wire edge is seen; next, rub them on the oilstone, first on the bevel side and then flat on the stone with the bevel side up. Repeat until the wire edge disappears and the edge becomes sharp.

Saws must be sharp. The sharpening is not an easy matter, and pupils should be aided by some one who has had experience in doing this work.

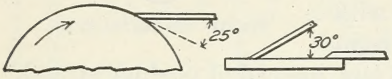


FIG. 14.—Methods of sharpening tools.

TERMS USED IN WOODWORKING.

Certain terms are used in describing woodworking operations. These are (1) cutting the stock or lumber, (2) squaring up the stock, (3) laying out the work, (4) cutting to lines, and (5) assembling the parts.

By cutting the stock is meant the getting of the rough pieces of lumber ready to make the article. For finishing, add one-sixteenth inch to the thickness, one-eighth inch to the width, and one-half inch to the length of each piece. The width and thickness of rough lumber are always somewhat less than the stated dimensions. For example, a so-called inch board is usually seven-eighths inch in thickness. This must be kept in mind when cutting stock. Always try to avoid waste. To do this one must measure and calculate carefully before cutting the pieces.

Squaring up the stock means making the rough piece into one that has smooth, flat, straight sides that are at right angles and that is of the desired length, breadth, and thickness. The term "finished stock" is applied to stock that has been squared up. When squaring up stock you should establish a working face and a working edge. To establish a working face plane the board on one side. When planing place the board on the bench with the grain of the wood away from you and push it against the bench stop; begin planing along one edge of the face, take a stroke the length of the board, and continue in this way, moving across the piece. Test the surface by means of the try square. This is done by placing the edge of the square on the planed surface as shown in figure 15, moving it about, and noticing if it touches at all points. If the face is not smooth, as indicated by the try square, continue planing until it is. This smooth face is the working face. Mark it with a cross (×) or some other mark to distinguish it.

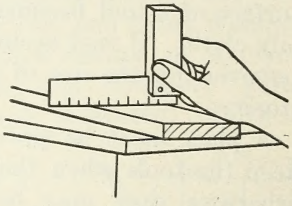


FIG. 15.—Testing the surface.

The working edge is obtained by planing one edge until it is smooth and square with the working face. To test the edge, place the beam

of the try-square against the working face and the blade against the edge, as shown in figure 16, and slide the square along the board. If the blade touches along the entire edge the working edge is at right angles to the working face.

Gauging the width and the thickness is another operation in squaring up the stock. Set the gauge to the desired width and thickness and, working from the working face or the working edge, draw gauge lines to show the desired width and thickness of the finished piece of stock. Plane to the gauge line and test with the try square.

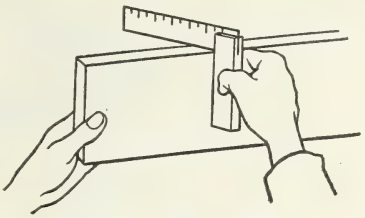


FIG. 16.—Testing the edge.

Measuring for length is another detail of squaring up the stock. Square a sharp pencil line across the working face and the working edge near one end of the board, as shown in figure 17, saw off the end just outside the line, and plane to the line. Measure the length and make a point to indicate its location, square a line through the point, saw to length just outside the line, and plane to the line as before directed.

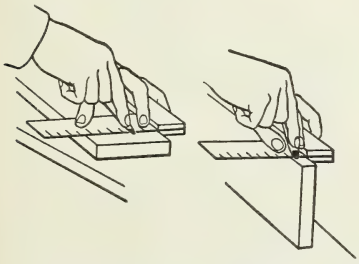


FIG. 17.—Squaring across a board.

Laying out the work has reference to the drawing of lines on a piece of finished stock to indicate the shape it is to be cut. The work should be laid out on the working face and the working edge.

Cutting to lines means to remove the stock to the lines that have been laid out.

Assembling the parts has reference to the fastening of the different pieces together.

USE OF DRAWINGS.

Accompanying most of the exercises are drawings that will aid in the work. The drawings are of three kinds: (1) Perspective drawings, which show the appearance of the finished article; (2) detail drawings, which show the size and the shape of each part; and (3) working drawings, which show the outline of the articles when viewed from the top, the front, and the end. In order to get the three different kinds of drawings clearly in mind refer to figure 18. At the top is shown the perspective drawing of the article, a nail box; below this is the detailed drawing marked sides, bottom, ends, handle; below this is the working drawing marked top view, front view, end view. The outlines in working drawings are what would be seen if one looked squarely down on the top, the front, and the end of the article. In

figure 19 is shown the working drawing of the nail box described and illustrated in Exercise 1, with the front, top, and end views, looked at in the directions of *A*, *B*, and *C*, drawn out and shown in heavy lines to illustrate how they are obtained. In the working drawing of figure 18, these views are shown laid out flat. Solid lines in working

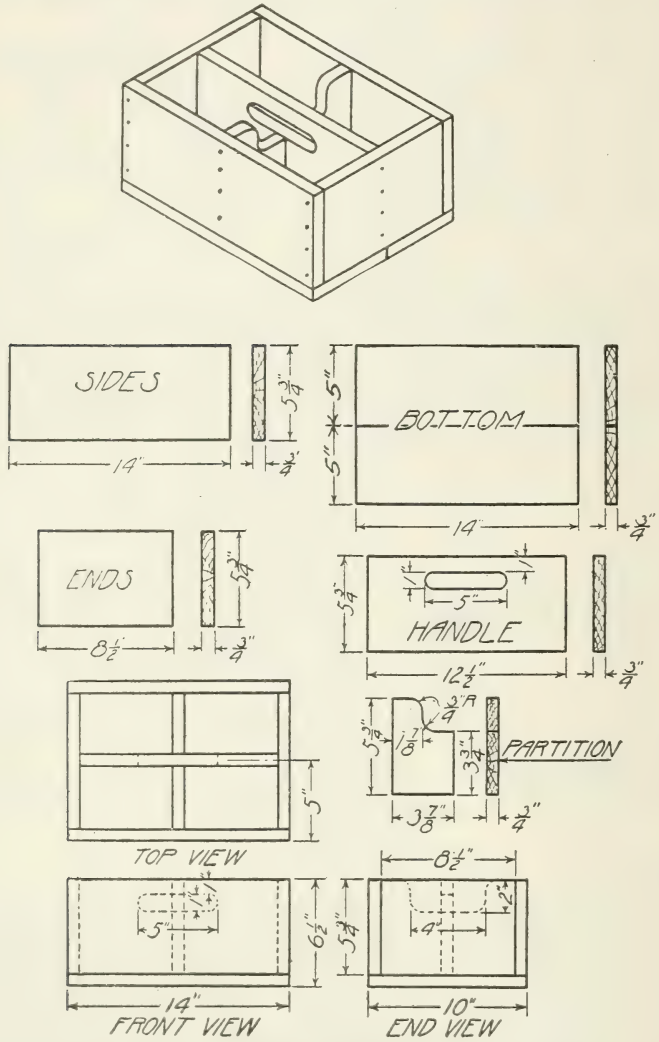


FIG. 18.—Nail box.

drawings show the front edges of the boards; those that can be seen. Dotted lines indicate the edges of boards that can not be seen, because of boards in front of them.

In some of the exercises all three kinds of drawings are shown. In others only the perspective drawing is shown, as it in itself will show how to make the article.

EXERCISE I. NAIL BOX.

A nail box will be needed in connection with the woodworking exercise. The one shown in figure 18 is equipped with two compartments and a handle; it will be found convenient for use in the school and about the farm.

The material required is one-fourth pound of 8-penny finishing nails and a piece of lumber 1 by 6 inches by 8 feet 6 inches. This piece is cut with finished dimensions as follows:

Use.	Number of pieces.	Finished dimensions.
		Inches.
Sides	2	$\frac{3}{4}$ by $5\frac{3}{4}$ by 14.
Ends	2	$\frac{3}{4}$ by $5\frac{3}{4}$ by $8\frac{1}{2}$.
Bottom	2	$\frac{3}{4}$ by 5 by 14.
Handle	1	$\frac{3}{4}$ by $5\frac{3}{4}$ by $12\frac{1}{2}$.
Partitions	2	$\frac{3}{4}$ by $5\frac{3}{4}$ by $3\frac{3}{8}$.

Cut the pieces called for, allowing $\frac{1}{8}$ inch in width and $\frac{1}{2}$ inch in length on each one; remember that finished dimensions are given above. Plane one of the surfaces of a side smooth and flat to form the working face and test it with a try square. When finished, mark it with a cross (×). Plane one of the edges square with the working face to form the working edge. Test with the try square. When finished, mark it with a check (V) to designate it as the working edge. Gauge for thickness by setting the marking gauge at $\frac{3}{4}$ inch and marking a line from the working face along the edges. Plane the board down to this gauge line and square the side with the working edge. Gauge for width in the same way, measuring from the working edge. Square a pencil line across the working face and working edge near one end, saw the board just outside this line, and plane carefully to the line. Measure the finished length. Finish the other end of the piece in the same way.

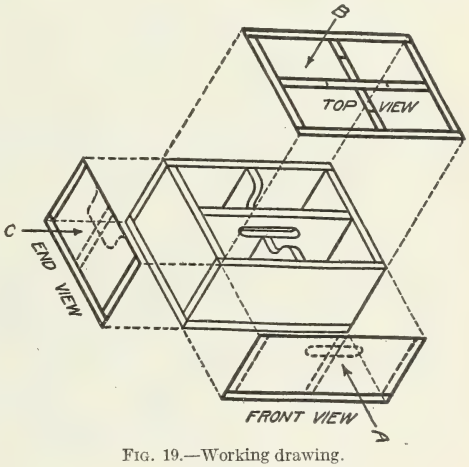


FIG. 19.—Working drawing.

Follow the same plan in making the ends and bottom.

To assemble the frame, nail the sides to the end pieces, as shown in the drawing. Plane the edges if necessary to make them fit evenly. Fasten the bottom to the frame. To do this fit the bottom boards to

the edges of the frame, test the corners with a try square to make sure the frame is square, and nail the bottom to the frame.

To make the handle, follow the same directions for squaring up the stock as given for the sides, ends, and bottom. Lay out lines for a hole for the handle, as shown by the drawing. This hole is 1 inch wide and 5 inches long and is placed 1 inch from the top and midway from the ends of the piece. Cut out most of the wood from the hole with a chisel or a brace and bit, and with a knife or chisel carefully smooth to the lines and round the handle. Place the board that forms the handle in the proper place in the box and nail securely.

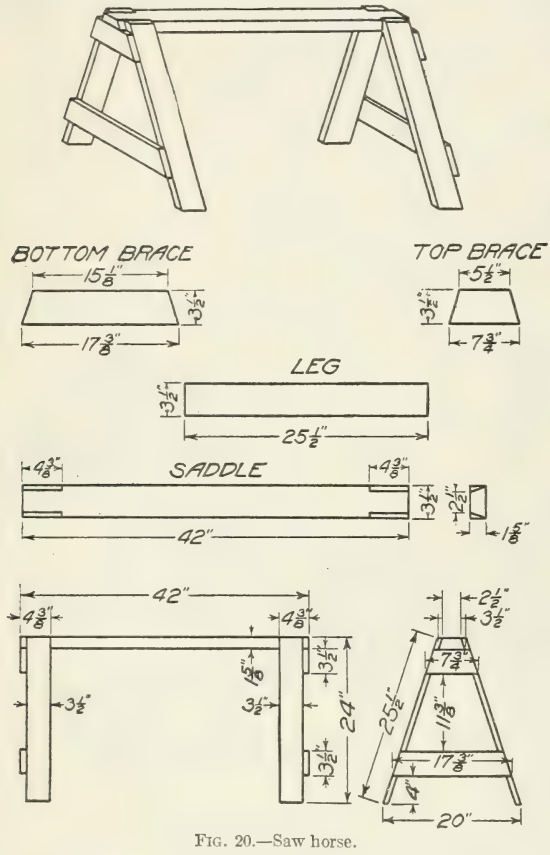


FIG. 20.—Saw horse.

To make the partition pieces, square up the stock as previously directed for other pieces. Lay out the lines for shaping the top of the partition pieces, as shown in the drawing, either by hand or with a rule and compass. Cut out most of the wood with a saw, and trim with a knife to the line. Place the partition pieces in the box, as shown in the drawing, and nail in place.

Plane off any unevenness that is found, and the box is finished.

EXERCISE II. SAWHORSE.

A pair of sawhorses will be a convenience in making the woodworking articles. Explicit directions for making a very serviceable pair are given in this exercise. Figure 20 gives the necessary drawings.

The lumber required is one piece hard pine 2 by 4 inches by 5 feet, and two pieces white pine 1 by 4 by 16 inches. The lumber should be what is known as No. 1 common S4S. The abbreviations S4S and

S2S are used to designate lumber surfaced on four sides or two sides, respectively. The hardware required for the sawhorse is ½ pound of 8-penny nails and 1 pound of 10-penny nails.

The bill of stock with finished dimensions and the use of the pieces are as follows:

Use.	Number of pieces.	Finished dimensions.
		Inches.
Saddle	1	1⅜ by 3½ by 42.
Legs	4	⅞ by 3½ by 25½.
Top brace	2	⅞ by 3½ by 7¾.
Bottom brace	2	⅞ by 3½ by 17⅜.

Cut the pieces called for above, allowing ⅛ inch in width and ½ inch in length for the finishing. It is not necessary to trim the length to the exact measurement.

Next, lay out the saddle and the braces. In laying out the saddle first lay out the shoulder on the ends of the piece, as shown in the drawing. Saw out these shoulders, making them 2½ inches wide at the top, 3½ inches at the bottom, and 4⅜ inches long. Smooth up the shoulders with a chisel. Lay out the top brace, making one edge 5½ inches long and the other 7¾ inches long, then lay out the bottom brace, making it 15⅛ inches on one edge and 17⅜ inches on the other. Do not cut off the ends until you assemble the parts.

The next step is to assemble the parts. Nail the legs on the beveled shoulders of the saddle. Have the inside edges of the pieces even with the top of the saddle. The outside corners will be sawed off later.

Use 10-penny nails, driving them partly in. Measure 25½ inches from the top end and square a line across the face or the edge of the piece. This is the length of the legs. Tack a strip of board across the bottom of the legs to hold them 20 inches apart. Try the top braces to see if they fit. If they do, saw off the ends and nail them in place, using 8-penny nails. If they do not, square them up to fit. Fit the bottom braces in place in the same manner. Saw off the outside corners of the top of the legs and plane them even with the surface of the saddle. Saw off the lower ends of the legs to make the horse stand firmly on the floor.

EXERCISE III. BIRD HOUSE.

The study of birds is an important phase of agricultural work. Birds are the farmers' friends; they destroy insects and weed seeds. In addition, their presence about the farm home helps to make the surroundings attractive. In order that birds may be provided with shelter, houses for them should be built and placed near the school buildings and homes. Figure 21 shows an attractive and easily constructed bird house.

The material required for this house is one piece of clear white pine $\frac{1}{2}$ by 6 inches by 6 feet, S4S, and a small quantity of 1-inch brads or shingle nails. Often a box can be found that will contain enough $\frac{1}{2}$-inch pieces to make the house. Take the box apart carefully to avoid splitting the wood.

The bill of stock with finished dimensions and the use of the pieces are as follows:

Use.	Number of pieces.	Finished dimensions.
		Inches.
Bottom	1	$\frac{1}{2}$ by 6 by 10.
Sides	2	$\frac{1}{2}$ by 4 by 8.
End	2	$\frac{1}{2}$ by 4$\frac{1}{8}$ by 6.
Roof	1	$\frac{1}{2}$ by 4 by 10.
Roof	1	$\frac{1}{2}$ by 4$\frac{1}{2}$ by 10.

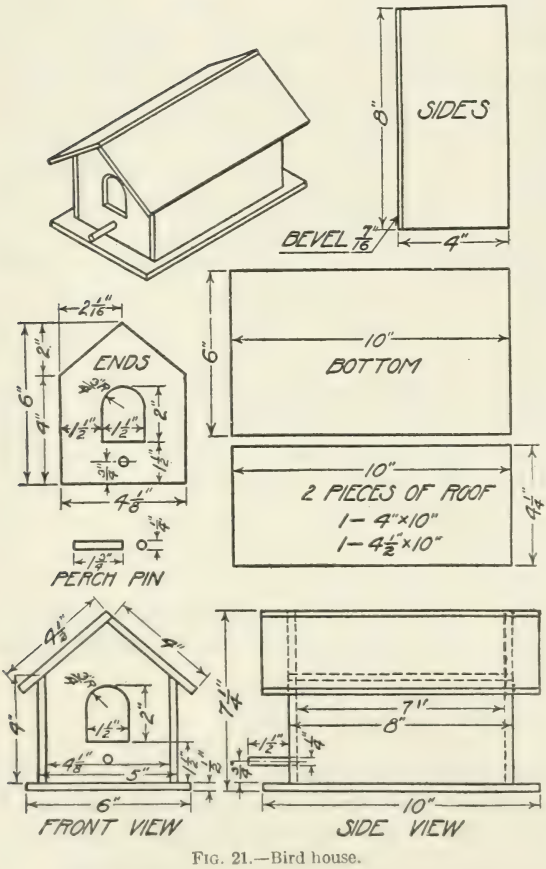


FIG. 21.—Bird house.

Cut and square up the pieces according to the dimensions given above, bevel the sides as shown in the drawings, lay out the door and perch pin hole on one end, as shown in the drawing, bore a $\frac{1}{4}$-inch hole for the perch pin, bore $\frac{3}{4}$-inch holes along the inner side of the line laid out for the door, trim to the lines with a knife, lay out and cut the end boards to the proper slant for the roof.

In assembling the parts, nail the sides to the end pieces, using the 1-inch brads or shingle nails, nail bottom to frame, nail on roof boards, whittle a perch pin $\frac{1}{4}$ inch in diameter and 2 inches long and wedge it in the hole below the door. The bird alights on this pin before entering the door. Paint the bird house; a dark green or a brown is a good color.

NOTE TO TEACHER.—This exercise may be correlated with drawing, language, or geography, as well as agriculture. Have the pupils make a drawing of the house to scale. Let them design and build other types of houses and put them up at home and about the school yard. See list of references given, especially Farmers' Bulletin 609. Language-lesson topics that may be used are: Birds, the Farmers' Friends, Food of Birds, Nature Study and Birds, and Where Birds Migrate. As a geography lesson have the pupils locate the States to which the birds migrate and study the climatic conditions of these States. As lessons in agriculture make studies of the feeding habits of birds and learn what weed seeds and insects are eaten by birds. Learn methods of keeping crows from taking freshly planted corn.

List of U. S. Department of Agriculture publications on birds.

DEPARTMENT BULLETINS.

No. 107. Birds in Relation to Alfalfa Weevil.
128. Distribution and Migration of North American Rails and Their Allies.
171. Food of Robins and Bluebirds of United States
185. Bird Migration.
187. Preliminary Census of Birds of United States.
205. Eleven Important Wild Duck Foods.
217. Mortality Among Waterfowl Around Great Salt Lake, Utah.
280. Food Habits of the Thrushes of the United States.
292. Distribution and Migration of North American Gulls and Their Allies.

FARMERS' BULLETINS.

No. 493. The English Sparrow as a Pest.
497. Some Common Game, Aquatic, and Rapacious Birds in Relation to Man.
506. Food of Some Well-known Birds of Forest, Farm, and Garden.
609. Bird Houses and How to Build Them.
628. Game Laws for 1914.
621. How to Attract Birds in Northeastern United States.
630. Some Common Birds Useful to the Farmer.

YEARBOOK SEPARATE.

No. 620. American Thrushes Valuable Bird Neighbors.
642. Shore Birds and Their Future.

BIOLOGICAL SURVEY CIRCULAR.

No. 94. Directory of Officials and Organizations Concerned with Protection of Birds and Game. 1913.

EXERCISE IV. SEED GERMINATOR.

In figure 22 is shown a type of seed germinator that is very convenient for testing seed corn. The box is divided into squares by broom wire or cord. Sand or soil is placed in the box, and the kernels are planted in the squares. The rows of squares are numbered one way of the box and lettered the other way. Each square can then be designated by a number and a letter in the same manner as cities and countries are often designated on maps. For example, the upper left hand square is A 1, the upper right hand one, A 10. When corn is to be tested, the ear from which a group of kernels is taken is designated by the same letter and number as the square in which it is planted.

The material required is one piece $\frac{7}{8}$ by 10 inches by 2 feet, one piece $\frac{5}{8}$ by 12 inches by 4 feet, about 32 feet broom wire or cord, and a few 6-penny and 8-penny finishing nails. The stock, with finished dimensions and use of each piece of lumber, are as follows:

Use.	Number of pieces.	Finished dimensions.
		Inches.
Sides	2	$\frac{3}{4}$ by 2 by $20\frac{3}{4}$.
Ends	2	$\frac{3}{4}$ by 2 by $19\frac{1}{2}$.
Bottom	2	$\frac{1}{2}$ by $9\frac{3}{4}$ by $21\frac{1}{2}$.

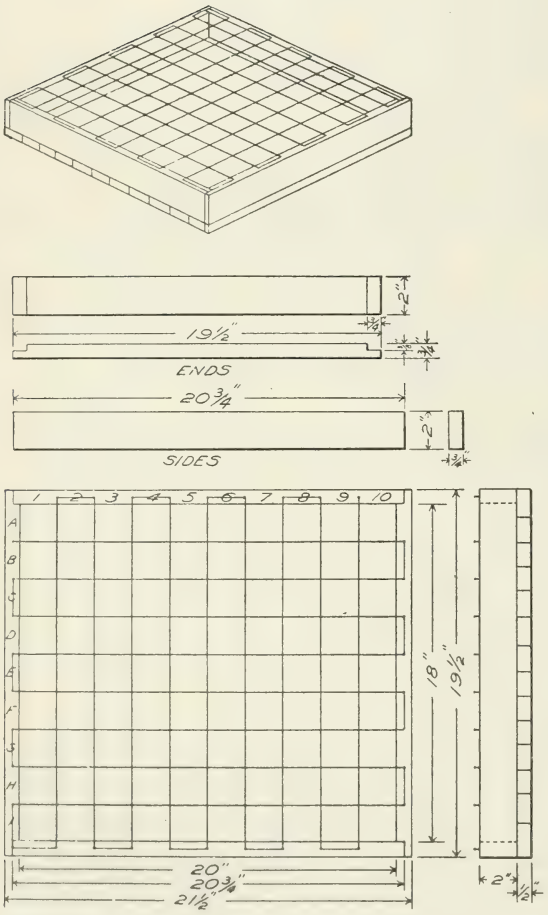


FIG. 22.—Seed germinator.

Rip the $\frac{7}{8}$ by 10 inch by 2 foot board, making four strips, each $2\frac{1}{4}$ inches wide. Cut to lengths of sides and ends and plane to dimensions given above. Saw from the $\frac{5}{8}$ by 12 inch by 4 foot board two pieces, each $21\frac{1}{2}$ inches long and plane to dimensions. Cut notches in ends of end pieces as shown in the drawing.

To assemble, nail the ends to sides. Use 8-penny nails, putting three nails into each cover, two through the end pieces into the side pieces, and one through the side piece into the end piece. This method of nailing makes a good strong corner. Be careful not to split the wood when nailing. Next, nail the bottom boards in place, using 6-penny nails. Cover the crack between the two bottom boards with a narrow strip of wood to prevent the sand or soil from sifting through the crack.

To provide pegs on which to string the wire to make the squares, drive 6-penny nails 2 inches apart into the top edges of the sides and ends of the box, allowing the heads to project $\frac{1}{4}$ inch above the surface of the wood. Stretch the broom wire or cord around the nails to form the division, as shown in the drawing. Print letters and figures along one end and side, as shown in the drawing. Place sand or soil in the box, and it is ready for use.

A seed germinator similar in construction to the one just described, but without the wires, is often used in seed-corn testing work. Figure 23 shows a perspective drawing of a convenient-sized tester of this kind. The box is $12\frac{1}{2}$ inches wide, $18\frac{1}{2}$ inches long, and 2 inches deep. A box of this size will test 45 ears of corn. The box used in the previous exercise can be used if desired. Half fill the box with sand or sawdust that has been soaked in water at least an hour, pack the material level, and above it stretch a piece

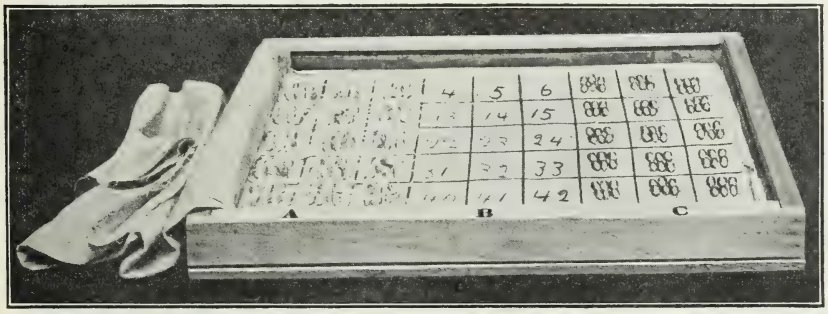


FIG. 23.—Seed germinator.

of muslin that has been ruled into 2-inch squares. Number the squares from 1 to 45, as shown in the illustration. Place the kernels to be tested, germ side up, in the spaces, cover the cloth with another piece of cloth a few inches larger than the box, and place wet sand or sawdust above this cloth. Cover the box with a piece of glass or oilcloth to prevent evaporation of the moisture and set it away in a warm place for a few days. When examining the kernels to see if they have germinated, always roll the top cloth back carefully, otherwise you are likely to get the kernels from the different squares out of place. In the illustration the part marked A shows germinated kernels, that marked B the numbered squares, and that marked C the kernels ready to be tested.

Instead of filling the box with sand or sawdust, the seed bed can be made of heavy canton flannel or similar material. Use two or three thicknesses in the bottom of the box and one or two thicknesses for covering the kernels. A new cloth should be washed before using. It is well to bear in mind that canton flannel comes

27 inches wide. A box of the dimensions given above is just the right width for canton flannel once folded, allowing for shrinkage.

For use, soak the cloth in water and place the half of the cloth, double thickness, which has been marked in squares, in the bottom of the germinating box. Place the kernels from ear No. 1, germ side up, in square No. 1, and so on, as already described. When all of the squares have been filled fold the other end of the cloth carefully over the kernels. If during the sampling the cloths have become dry, sprinkle them well with water.

The principal advantage of this method is that it is almost impossible to injure the corn by the addition of too much water, as is frequently done where tests are made in sand or sawdust.

FIG. 24.—Rag-doll seed tester.

In making the box, follow directions (except with regard to dimensions) given for the box shown in figure 22. One should have no difficulty in figuring the amount of material required, cutting the pieces into the proper lengths and assembling them.

In figure 24 is shown what is known as the rag-doll tester.[1] This is one of the cheapest as well as most convenient and accurate methods of testing seed corn. It requires no box.

To make this tester, secure sheeting of a good quality and tear into strips from 8 to 10 inches wide and 3 to 5 feet long. Where these are to be used very much it is well to hem the edges, as otherwise the ravelings sometimes disarrange the kernels in unrolling. Each cloth should then be marked with a heavy pencil; first, lengthwise in the middle, and then crosswise, as shown in the accompanying illustration, making squares about 3 inches wide. Number the squares as shown in the illustration.

Moisten one of these cloths and lay it out on a board of convenient size in front of the ears which are to be tested. Place kernels from each ear in squares numbered to correspond to number of ear. When the cloth has been filled, begin at the upper end with ears Nos. 1 and 2, etc., and roll the cloth up. Since the cloth is moistened,

[1] The description and illustration are based on Iowa Agricultural Experiment Station Bulletin 135.

the kernels will not push out of place. If a small irregular-shaped piece of wood or some other substance is used as a core in rolling, a more uniform germination may be secured. When the rolling of the cloth has been finished, tie a string rather loosely about the middle of the roll, or, better still, use a rubber band, and number this roll No. 1. Then proceed with roll No. 2 in the same way. As many rolls may be used as are necessary to contain the corn which one has to test. From 20 to 50 ears may be tested in each roll, depending upon the length.

After the rolls have been filled they should be placed in a bucket of water, where they may remain for from 2 to 18 hours, depending upon the preference of the operator. At the end of this time pour off the water and turn the bucket upside down over the rolls—or a common dry-goods box may be used for this purpose. A couple of small pieces of wood should preferably be laid under the rolls, and one edge of the pail should be lifted from $\frac{1}{2}$ to 1 inch in order to give sufficient ventilation. Some have left the pail in an upright position, placing a few sticks or corncobs in the bottom of the pail to insure proper drainage, and then packing a moist, coarse cloth over the rolls to prevent excessive drying. At the end of five days the kernels should be ready to read.

Depending upon the arrangement of the ears, select, first, either roll No. 1 or the last roll filled. This cloth will be unrolled in front of the ears which are represented. Examine all the kernels carefully. In all cases in which all six kernels are not strong in germination the ear should be thrown away.

NOTE TO TEACHER.—One of the very best lines of agricultural work for schools is the testing of seed corn. It is a means of getting not only the pupils, but also the parents interested in agriculture. Often the latter is a very important consideration in the success of the work. It pays to test seed corn, for it is often the means of preventing a poor stand or the replanting of a crop.

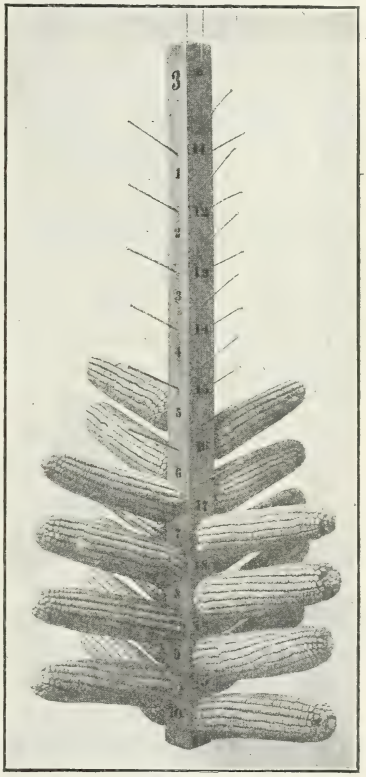


FIG. 25.—Seed-corn drying rack.

As correlations with the agricultural work and the manual-training exercise, have the pupils compute the value of the lumber in a box, the value of the time to make it, the cost in time of testing, say, 100 ears of corn, and use the figures obtained in formulating problems to determine whether or not the testing of seed corn is an expensive practice.

EXERCISE V. SEED-CORN DRYING RACK.

Seed corn should be stored in a cool, dry place, and the ears should be kept apart, in order that air can circulate freely about them. A very convenient and easily constructed rack is shown in figure 25. To make this rack, rip a piece of 2 by 4 inch in strips 2 by 2 inches

and 6 feet long. Exact measurements, however, are not necessary. Smooth up the pieces, bore a half-inch hole near one end, and loop a rope through it. This rope is hung over a nail or hook in the ceiling of the storage room when the rack is in use. Drive 10 finishing nails on each side of the piece, spacing them 5½ inches apart. Number the nails from 1 to 40 (there will be 10 on each side of the piece). This may be done with a pencil, or figures may be cut from a calendar and the numbers pasted on the wood. When the rack is to be used, the butts of the corncobs are stuck on the nails, as shown in the illustration.

NOTE TO TEACHER.—The pupils should be impressed with the necessity of storing seed corn properly. The making of these racks by the pupils will create an interest in this phase of the work. In Farmers' Bulletins other devices for drying seed corn are given.

EXERCISE VI. SEED SAMPLE CASE.

Collections of farm seeds, weed seeds, and farm seeds containing weed seeds as impurities should be made in the schools and kept for use in studying crops, weeds, and seed adulterations. To care for such collections properly, a case to hold the seeds is necessary. Figure 26 shows a convenient case in which small bottles of seeds may be stored. The bottles are straight sided, ½ inch in diameter and 2½ inches deep; they can be purchased at drug stores for about 10 cents a dozen. Those with screw tops are more convenient than those with corks.

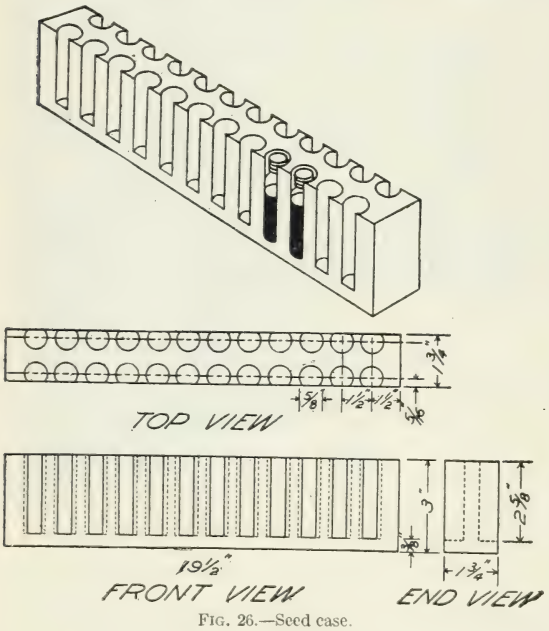


FIG. 26.—Seed case.

The material required for making the case is a piece of white pine 2 by 4 by 20 inches. Finish the piece to the dimensions shown in the drawing, 1¾ by 3 by 19½ inches. Gauge two lines 5/16 inch from both sides on one edge. On these gauge lines lay off centers for holes 1½ inches apart, beginning 1½ inches from one end. Place the piece, with a strip of scrap board against it on one side, in a vise, and with a ⅝-inch bit and brace bore holes 2⅜ inches deep on the centers that have been laid off. The scrap board prevents the lumber from

slivering. Bore the holes straight into the wood. See directions on page 5. To aid you in boring the holes to the exact depth desired, bore a $\frac{5}{8}$-inch hole lengthwise through a piece of scrap lumber $1\frac{1}{2}$ by $1\frac{1}{2}$ by 4 inches, and slip this on the shank of the bit to form a collar; the bit should extend $2\frac{5}{8}$ inches beyond the collar. Bore a trial hole in a piece of scrap lumber with this collar on the bit; if the hole is too shallow, cut off the end of the collar to get the correct length; if the hole is too deep, make another collar. After the holes are bored, trim the edges along the sides of the piece until each opening is $\frac{3}{8}$ inch wide. Paint or stain the case; this will improve its appearance as well as preserve the wood.

NOTE TO TEACHER.—Collections of seeds are very useful aids in teaching agriculture. A pupil will get a much better idea from examining the seeds themselves than by reading about them. If you are to do efficient work in crop studies, you must have the seeds and, moreover, they must be arranged in some kind of order and be of convenient access. The seed sample case solves the question of a place in which to put the seeds. For an extended discussion of this subject see Farmers' Bulletin 586.

Descriptions of weed seeds and methods of eradication are good topics for written lessons. Many weeds have been introduced into the United States from foreign countries; the Russian thistle, for example. A study of the climate and plants of these countries will add to the interest of the geography lessons. Enlarged drawings of seeds as they may be seen under a lens are useful, not only for their agricultural value, but for the drawing lessons as well.

EXERCISE VII. HOTBED AND COLD FRAME.

A hotbed is a bed of fertile soil surrounded by a glass-covered frame, usually of wood, and heated artificially. As a rule fresh stable manure is placed in the bottom of a hotbed as the source of heat. A cold frame is a box-like frame covered with glass or muslin. These frames are similar to hotbeds except that no heat is supplied artificially. The sun's rays through the glass are depended upon as the source of heat. The principal use of hotbeds is for the production of plants for early setting. Cold frames are used primarily to harden off plants that have been started in a hotbed. They are used also to mature crops earlier in the season than if they were grown in the field and to lengthen the growing season of certain crops that do not normally mature in a given locality. Temporary cold frames are sometimes built over partly grown crops in the field; lettuce, for example, for the purpose of protecting the plants during the cold weather of early spring and hastening their growth. Hotbeds and cold frames should be set in well-drained soil and should slant toward the south.

The most common sash used for hotbeds and cold frames is 3 feet wide and 6 feet long, with the side pieces, known to gardeners as stiles, extending 2 inches beyond the ends. These projections

serve to strengthen the corner joints, and they are used as handles when removing the sash from the frame. The sash when in use is laid on the frame, the weight holding it in place.

Figure 27 shows a simple one-sash cold frame that can be used also as a hotbed by placing it over an excavation in which has been placed 2 inches of ashes or stone, 3 or 4 inches of straw, and a layer of fresh horse manure. The thickness of the manure will vary from 6 to 24 inches,

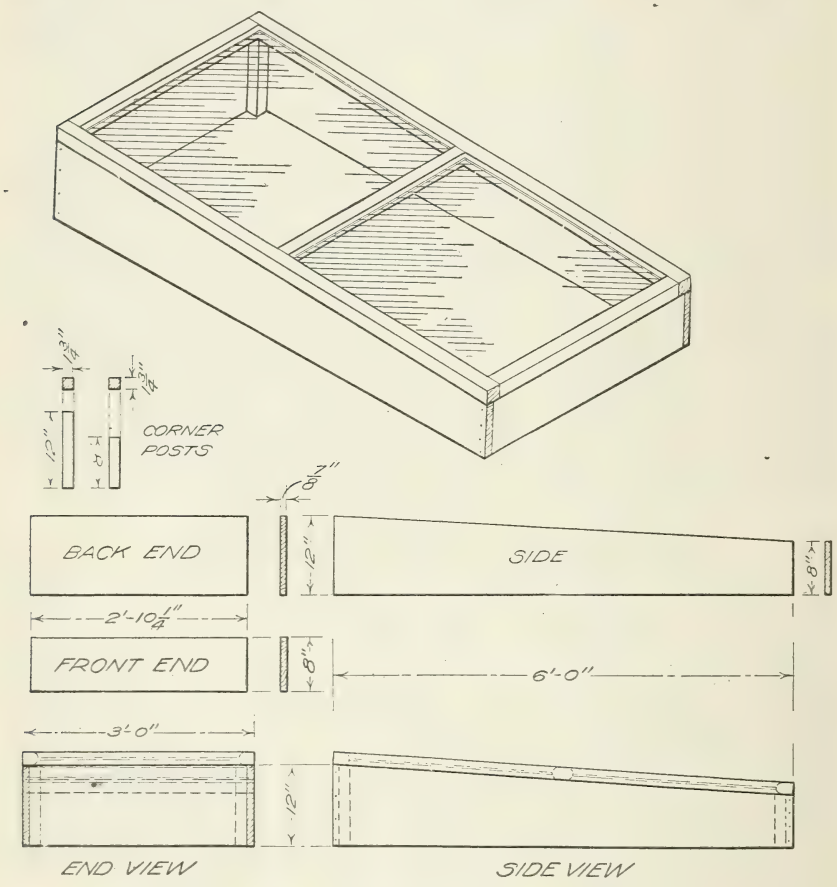


FIG. 27.—Cold frame.

depending on the climate and the season. Above the manure, 2 or 3 inches of straw and 5 or 6 inches of mellow soil are placed. When the frame is used as a cold frame it is placed directly over the soil in which the vegetables are to be grown; this soil should be put into a good state of tilth before the frame is built.

The material required for the frame shown in figure 27 is one piece of board $\frac{7}{8}$ by 12 inches by 15 feet, one piece $\frac{7}{8}$ by 8 inches by 3 feet, one piece 2 by 4 by 21 inches (if a piece of 2 by 4 inch dressed lum-

ber is used it will probably measure $1\frac{5}{8}$ by $3\frac{1}{2}$ inches), one glass sash 3 by 6 feet, and a quantity of 8-penny common nails.

The bill of stock with finished dimensions and uses of the pieces is given below:

Uses.	Number of pieces.	Finished dimensions.
Sides	2	$\frac{7}{8}$ by 12 inches at one end and 8 inches at the other by 6 feet.
Back	1	$\frac{7}{8}$ by 12 inches by 2 feet $10\frac{1}{4}$ inches.
Front	1	$\frac{7}{8}$ by 8 inches by 2 feet $10\frac{1}{4}$ inches.
Posts at back	2	$1\frac{3}{4}$ by $1\frac{3}{4}$ by 12 inches.
Posts at front	2	$1\frac{3}{4}$ by $1\frac{3}{4}$ by 8 inches.

Cut from the $\frac{7}{8}$ by 12 inch by 15 foot board two pieces 6 feet long and one piece 3 feet long to form the sides and back pieces. Taper the side pins by laying off a slanting line on the board with one end 12 inches from the base and the other 8 inches, and saw and plane to this line. If the board lacks a little in width, say, if only $11\frac{3}{4}$ inches wide, use this dimension instead of the 12 inch. The back, too, will be the same length. Square up the 3-foot board cut from the large board to the dimension given for the back. From the 3-foot board (8 inches wide) given in the list of material, square up the piece for the front. Rip the 21-inch piece of 2 by 4 inches into two pieces and saw each in two to form the posts.

To assemble, place the corner posts on the inside ends of the side boards and nail with 8-penny common nails. Place end boards in position even with the side boards and nail securely. Saw posts flush with top. Lay the sash on the frame, and the cold frame is ready for use.

Note to Teacher.—Hotbeds and cold frames can be used very effectively in school and home garden work. They lengthen the growing season so much that several months more gardening work can be done by the pupils. In northern sections green plants can be grown in hotbeds as late as December, and in many southern sections cold frames make gardening possible all winter.

For further suggestions concerning the use of hotbeds and cold frames see Farmers' Bulletins 255, The Home Vegetable Garden; 642, Tomato Growing in the South; 647, The Home Vegetable Garden in the South; 460, Frames as Factors in Truck Growing.

School and Home Garden Circulars 1 to 10, published by the Bureau of Education, Department of the Interior, contain information about hotbeds and cold frames. These may be secured by writing to the Commissioner of Education, Department of the Interior, Washington, D. C.

EXERCISE VIII. FLATS.

Vegetable growers have much use for small wooden trays known as flats. They are especially useful in transplanting plants from the hotbed to the cold frame. In one method of transplanting the

gardener removes a quantity of plants from the hotbed to a warm room and transplants them to the flats. The flats with the newly planted seedlings in them are then placed in the cold frames. Later they may be transplanted to the soil of the cold frame or to the field direct.

Flats vary considerably in size. Perhaps the most common sizes are 20 to 24 inches in length, and 15 to 16 inches in width; $2\frac{1}{2}$ inches is the usual depth. The ends are in most cases made of $\frac{1}{2}$-inch material and the sides and bottom of $\frac{1}{4}$-inch material. Cracks $\frac{1}{8}$ inch in width are left in the bottom to provide for drainage.

FIG. 28.—Flat.

Figure 28 shows a flat 24 by 16 by $2\frac{1}{2}$ inches inside measurement. Make several flats of this or any other convenient size, using $\frac{1}{2}$-inch material for the ends and $\frac{1}{4}$-inch material for the sides and bottom. Leave $\frac{1}{8}$-inch cracks in the bottom. From the experience you have had in previous exercises you will be able to construct them without having the detailed instructions before you. Make out a bill of materials, a bill of stock, cut the pieces, square them up, and assemble them.

Inexpensive flats are often made by gardeners from soap or other similar boxes by sawing the box into sections about $2\frac{1}{2}$ inches in depth and nailing strips on these sections to form bottoms for the flats. Figure 29 shows how to mark out the box for sawing it into sections. Get a box and some pieces of $\frac{1}{4}$-inch strips for bottoms and make a few flats in this way. If the box has a bottom and a cover on it, you can use these for the bottoms of two of the flats.

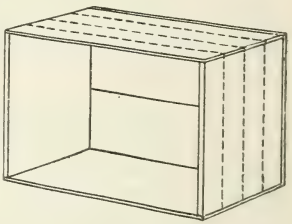


FIG. 29.—Method of marking box for sawing into flats.

NOTE TO TEACHER.—Flats should be found in every school where agriculture is taught. They may be used in connection with a hotbed and cold frame as described previously or be placed in sunny windows in the schoolhouse. Plants for study during the winter or for transplanting to the garden to secure early crops are often grown successfully in flats in schoolhouses. A shelf wide enough for the flats is built on a level with the window sill.

EXERCISE IX. FORCING BOX.

A very practical piece of equipment for use in forcing the growth of rhubarb and asparagus in the early spring is shown in figure 30. One of these boxes is placed over a clump of rhubarb or asparagus late in the fall or early in the spring, and barnyard manure is filled in around the box. The heat from the manure and from the sun's rays through the glass cover warms the soil under the box, and as a result the plants start to grow earlier. Often plants can be forced to pro-

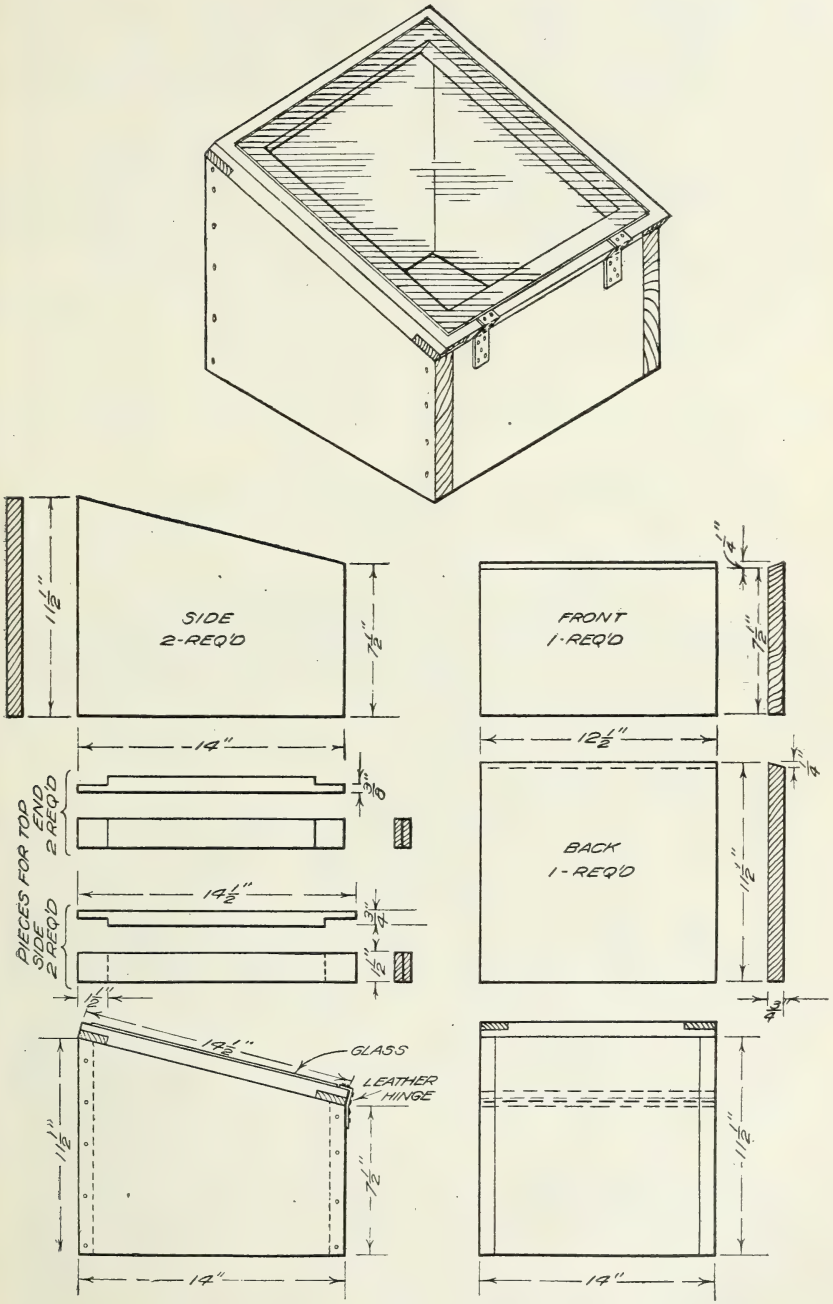


FIG. 30.—Forcing box.

duce a crop three or four weeks earlier than usual. Some gardeners place a half-barrel or a keg over the plants and cover it with manure to force them in the spring, but the forcing box is preferable on account of the heat that comes through the glass; also, because the plants—rhubarb especially—lack the green color when grown in the dark.

The material needed is one piece of board, cypress preferred, $\frac{7}{8}$ by 12 by 42 inches, one piece $\frac{7}{8}$ by 8 by 28 inches, one piece of glass 13 by 13 inches, a few 8-penny nails, 1-inch brads, and 10-ounce carpet tacks, and a piece of leather large enough for the two hinges.

The stock with finished dimensions and the use of each of the pieces are as follows:

Use.	Number of pieces.	Finished dimensions.
		Inches.
Back	1	$\frac{3}{4}$ by $11\frac{1}{2}$ by $12\frac{1}{2}$.
Side	2	$\frac{3}{4}$ by $11\frac{1}{2}$ at one end and $7\frac{1}{2}$ at the other end by 14 long.
Front	1	$\frac{3}{4}$ by $7\frac{3}{4}$ by $12\frac{1}{2}$.
Cover	2	$\frac{3}{4}$ by $1\frac{1}{2}$ by 14.
Do	2	$\frac{3}{4}$ by $1\frac{1}{2}$ by $14\frac{1}{2}$.

Cut the $\frac{7}{8}$ by 12 by 42 inch piece into three pieces, two of them $14\frac{1}{2}$ inches and the other 13 inches long. Square these up to dimensions given for back and side pieces. Bevel the back piece as shown in the drawing. To make the top edge of a side piece slanting, draw a line on the board with one end $11\frac{1}{2}$ inches from the base and the other $7\frac{1}{2}$ inches and saw and plane to this line.

Cut the $\frac{7}{8}$ by 8 by 28 inch piece of material into two lengths, one 13 inches long and the other 15 inches long. Square up the first of these pieces to form the front piece of the box. Bevel this piece as shown in the drawing. Rip the other piece into four strips, each $1\frac{7}{8}$ inches wide, and square up to form the four pieces of the cover. Lay off and cut the ends of these pieces to form the half-lap joints at the corners of the cover as shown in the drawing.

With the pieces all cut and squared up, the next step is to assemble the parts. Nail the front and back pieces to the side pieces, using 8-penny nails. Place the four strips of the cover in position and nail the half-lap joints, using 1-inch brads and bending them over on the under side. Fasten the cover to the box by means of the pieces of leather that form the hinges. Place the glass in position on the cover and drive carpet tacks into the wood along the front and sides to hold the glass in place. Also, drive two or three tacks along the back edge; these tacks can be removed and the glass slid out when ventilation is necessary or the plants are to be gathered.

NOTE TO TEACHER.—These forcing boxes can be made useful aids in teaching agriculture. If you have no rhubarb or asparagus in the school garden, undoubtedly you can get permission to use a few clumps at some near-by farm. The pupils will be interested in observing the difference between the forced and unforced plants, and, in addition, it will show them the necessity of warmth in plant growth.

The making of the boxes and their use in a garden will suggest good ideas for written lessons. As problems in arithmetic, have the pupils keep records of the sale prices of forced and unforced rhubarb and asparagus and compare the results, taking into account the cost of the boxes. As the boxes should last, say, five years, they should be figured at one-fifth of the actual cost.

EXERCISE X. SORTING TABLE FOR VEGETABLES AND FRUITS.

In figure 31 is shown a sorting table for use when packing vegetables and fruits. It is especially useful for tomatoes and apples. The

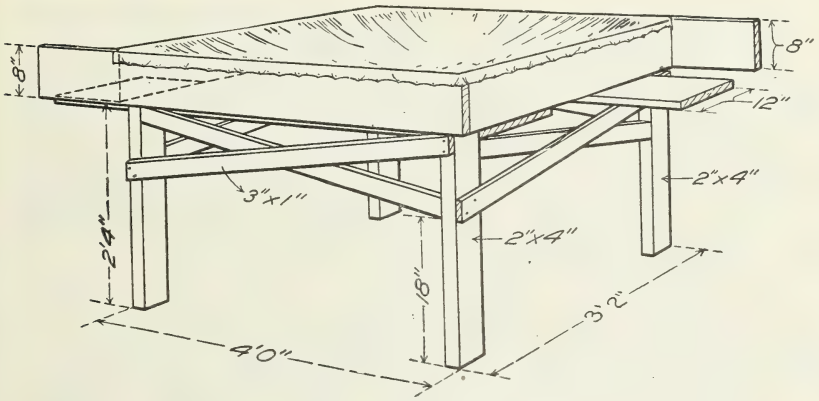


FIG. 31.—Sorting table.

table is 3 feet high, 3 feet 2 inches wide, and 4 feet long and will accommodate two packers. The top is made of burlap or canvas stretched loosely on the frame; this provides a yielding surface that will not bruise the product to be packed. The baskets or other containers to be filled are placed on rests made by a board extending across the bottom of the frame. Two of the side boards extend out a foot to provide a rest against which a box or other flat container can be leaned, if such a type is used.

The lumber required is one piece of 1 by 8 inches by 16 feet, one piece 1 by 12 inches by 10 feet, two pieces 1 foot by 3 inches by 10 feet, two pieces 1 foot by 3 inches by 8 feet, and one piece 2 by 4 inches by 12 feet. The other material required is two pieces of burlap or canvas, each 4 by 5 feet, 14 feet of old rubber hose, and a quantity of 8 and 10 penny nails.

The bill of stock is as follows:

Use.	Number of pieces.	Dimensions.
		Inches. Feet.
Frame	2	1 by 8 by 5.
Frame	2	1 by 8 by 3.
Rest boards	2	1 by 12 by 5.
Braces	4	1 by 3 by 5.
Braces	4	1 by 3 by 4.
Legs	4	2 by 4 by 3.

Saw the 16-foot board into four pieces to form the frame, the 10-foot board into two pieces to form the rest boards, the 2 by 4 inch into four pieces to form the legs, the two 10-foot strips into four pieces for braces that will run the long way of the table, and the two 8-foot strips into four pieces for braces that will run the short way of the table.

To assemble, nail the frame together, turn it upside down and nail the legs in place, using 10-penny nails, nail the rest boards in place, turn the table right side up and nail braces in place along the sides, using 8-penny nails, saw off the ends of the braces flush with the leg, nail the two thicknesses of burlap or canvas on the top of the frame, and nail the piece of rubber hose around the edge of the frame. This rubber hose gets rid of the sharp edge. If no hose is available, nail several thicknesses of burlap on the edge of the frame before the two thicknesses of burlap are fastened.

NOTE TO TEACHER.—As an aid in teaching agriculture, have one or two of these sorting tables made and carried to an orchard where apples are to be harvested. The pupils can be given some practical lessons in sorting the fruit. Be sure they learn that the burlap or canvas is to aid in protecting the fruit from bruising. After sorting a few baskets of fruit, compare them with an unsorted lot. The better appearance of the sorted fruit will often be a surprise to them. Too much fruit goes to market carelessly sorted.

These tables are useful in tomato-club work. A carefully sorted lot of tomatoes makes a much better appearance than a vine-run lot.

EXERCISE XI. PLANTING BOARD.

The usual method followed when laying out an orchard for planting is to set a stake at the point where each tree is to be located; but as this stake must be removed when the hole for the tree is dug, a planting board is often employed to get each tree in its proper place. In figure 32 is shown a drawing of a planting board, with the dimensions given. When using a planting board, the 2 by 2 inch notch is placed over the stake that indicates where the tree is to stand, and two stakes are driven into the ground at the points of the notches at both ends of the board. The board is then removed and the hole dug. When the tree is to be set, the planting board

is placed over the hole with the two notched ends over the stakes in the same position as before. The tree is placed in the hole at the position of the 2 by 2 inch notch in the board. Thus the tree stands in the same place as the stake did before the hole was dug.

To make a planting board, get a piece of 1 inch by 6 inch by 3 foot 6 inch lumber and saw out the notches as shown in the drawing.

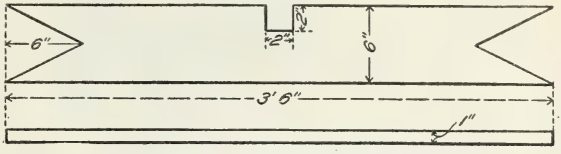


FIG. 32.—Planting board.

NOTE TO TEACHER.—The planting of an orchard is such an important part of fruit growing that some instruction about it should be given in the schools. An important item of the work is to get the trees in straight lines. The planting board described in this exercise is a means whereby this can be accomplished, and for this reason it is well to have each pupil make one.

EXERCISE XII. STAMPER FOR CRUSHING LUMPS OF FERTILIZER.

In the home mixing of fertilizer one of the tasks necessary in preparing the material is to crush the lumps of certain of the ingredients. A very handy tool for this work, and one easily constructed by the pupils, is the homemade stamper shown in figure 33. Tomake the stamper, cut off 18 inches from a piece of 6 by 6 inch hemlock, smooth up a 3-foot piece of hickory or other tough wood that is about the size of a pick handle, bore a hole in the end of the hemlock block, and wedge in the handle. Often an old pick or sledge handle can be used for the purpose.

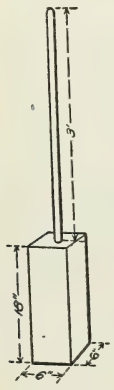


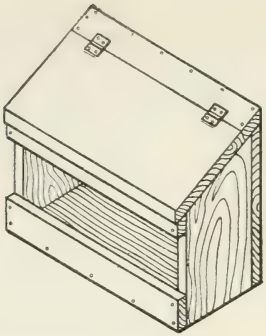
FIG. 33.—Homemade stamper for crushing fertilizer.

NOTE TO TEACHER.—The home mixing of fertilizer is a subject that should be taught in every country school. This simple exercise can be made the means of interesting your pupils, and also their parents, in the work. One of the arguments often given against the home mixing of fertilizer is the fact that some of the ingredients are likely to be lumpy. If you can get the pupils to mix a batch of fertilizer and use this stamper to crush the lumps, they will learn that the lumpiness of the ingredients usually is not a formidable objection to home mixing.

EXERCISE XIII. FEED HOPPER FOR POULTRY.

A very convenient hopper for grains and ground meals for use in poultry houses is shown in figure 34. It is easily constructed, inexpensive, and where used has given satisfaction.

The material required is one piece of cypress $\frac{3}{4}$ by 10 inches by 8 feet, two small hinges, 1 dozen $\frac{7}{8}$-inch screws, and a quantity of 6-penny finishing nails.



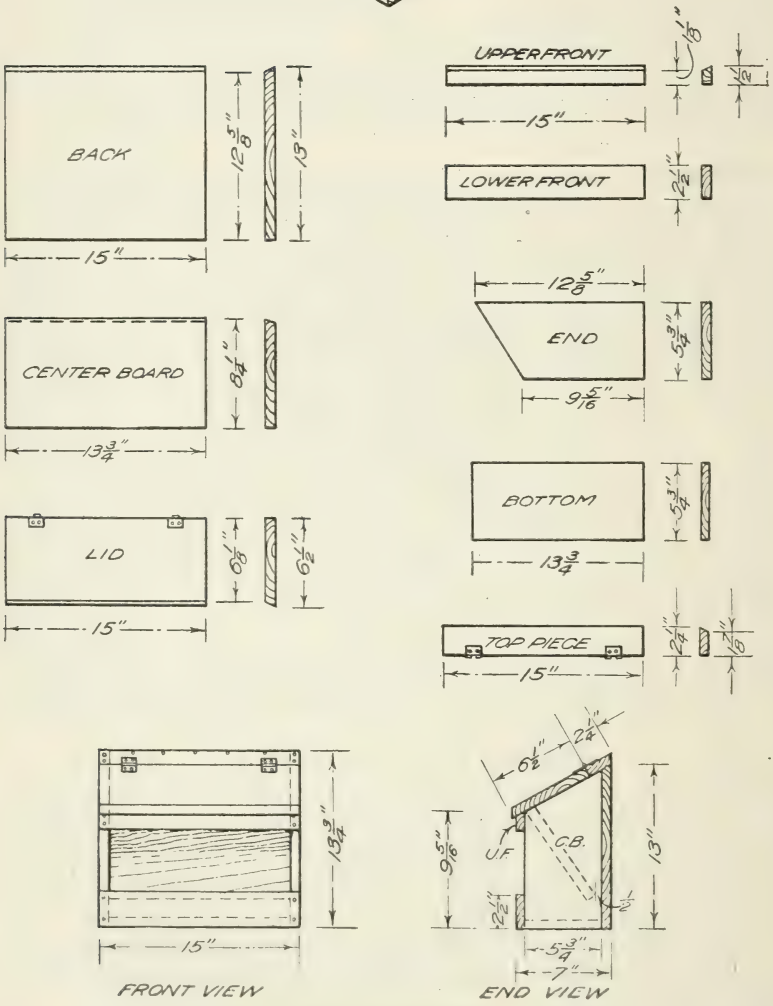


FIG. 34.—Feed hopper.

The bill of stock is as follows:

Use.	Number of pieces.	Finished dimensions.
		Inches.
Back	1	$\frac{7}{8}$ by 13 by 15 (this is made of 2 pieces).
Bottom	1	$\frac{7}{8}$ by $13\frac{3}{4}$ by $5\frac{3}{4}$.
Centerboard	1	$\frac{7}{8}$ by $8\frac{1}{4}$ by $13\frac{3}{4}$.
Ends	2	$\frac{7}{8}$ by $5\frac{3}{4}$ by $12\frac{5}{8}$.
Lid	1	$\frac{7}{8}$ by $6\frac{1}{2}$ by 15.
Upper part of front.	1	$\frac{7}{8}$ by $1\frac{1}{2}$ by 15.
Lower part of front	1	$\frac{7}{8}$ by $2\frac{1}{2}$ by 15.
Top piece	1	$\frac{7}{8}$ by $2\frac{1}{4}$ by 15.

Cut from the 8-foot board one piece $15\frac{1}{8}$ inches; from this piece rip off $5\frac{7}{8}$ inches and square up to make the bottom piece, and square up the other piece to be $3\frac{1}{2}$ inches wide for one of the pieces of the back. Cut another piece $15\frac{1}{8}$ inches long from the original board and square it up to $9\frac{1}{2}$ inches in width to form the second piece of the back. Bevel the top of the back, as indicated in the drawing. Cut a piece $13\frac{7}{8}$ inches in length from the original board and square it up to the dimensions required for the centerboard. Rip a strip $2\frac{3}{4}$ inches in width from what remains of the original board and cut and square up to form the upper and lower parts of the front, and the top piece. Bevel the pieces that form the upper part of the front and the top piece, as shown in the drawing. From the remaining part of the original board cut and square up the end pieces and lid. Bevel the lower end of the lid piece, as shown in the drawing.

To assemble, nail the end pieces to the bottom, nail the centerboard to the end pieces, carefully adjusting the centerboard to the correct position, as shown in the drawing, nail the upper and the lower pieces of the front to the end boards, nail the back to the end boards, placing the narrow piece above the wider piece, nail the top piece to the top of the end boards and the back, place the lid in position, and screw the hinges in place.

NOTE TO TEACHER.—Poultry is found on every farm, and this fact makes poultry husbandry an especially desirable subject to be taught in the schools. In order that the teaching may be profitable, it is necessary that the pupils take care of a few fowls, either at the school or at home as a home project or home practicum. The making of convenient appliances as described in this and some of the subsequent exercises will add much interest to the work.

EXERCISE XIV. TRAP NEST.

A trap nest is a laying nest so arranged that after a hen enters it she is confined until released by the attendant. By using such nests the egg record of each of the hens of the flock may be determined. A very convenient type of trap nest, the one used at the Government poultry farm, is described with full directions for making in Farmers' Bulletin 682. In working out this exercise, send to the Department of Agriculture for this bulletin and follow the directions given.

EXERCISE XV. BROOD COOP.

In figure 35 are shown detailed drawings of a brood coop described in Farmers' Bulletin 574. By following directions carefully you should be able to build one of these coops. The bill of material is as follows:

1 piece hemlock, 2 by 3 inches by 5 feet.
3 pieces white pine or spruce, 1 by 2 inches by 10 feet.
1 piece white pine or spruce, 1 by 3 inches by 3 feet.
2 pieces ½ by 2 inch stop, 30 inches long.
34 square feet ⅞-inch matched yellow-pine flooring.
1 pair 2 by 2 inch steel or japanned butts.
3 pounds 8-penny common nails.
1 piece wire netting, ½-inch mesh, 10 by 30 inches.
1 piece wire netting, ½-inch mesh, 9 by 15 inches.
2 pieces wire netting, ½-inch mesh, 4 by 4 inches.
A few staples.

The material should be examined to see that it is what was ordered; then the pieces should be laid out to cut with least waste, laying out first the longest pieces required.

To build the bottom of the coop, cut the 2 by 3 inch by 5 foot hemlock into two 30-inch pieces. Cut enough of the matched flooring into 18¼-inch lengths to cover the length of 28¼ inches. Nail the pieces of flooring to the 2 by 3 inch strips, nailing on the 3-inch face with 8-penny common nails. As shown in the sketch, the flooring is to be kept ⅞ inch back from the face and the ends of the 2 by 3 inch strips to allow for thickness of ends and sides.

To build the back, cut from the 1 by 2 inch white pine or spruce two pieces 28¼ inches long. Next, cut enough pieces of flooring 16 inches long to cover 30 inches. Nail the flooring to the 1 by 2 inch strips as illustrated, observing that the strips are kept back at each end ⅞ inch to allow for the sides to fit in, and the bottom strip up ⅞ inch to fit over the coop bottom.

The end sections are made in pairs—right and left. From the 1 by 2 inch strips cut one piece 16½ inches and one about 21 inches long. Cut enough pieces of flooring 26 inches long to cover 19 inches. Place the bottom strip ⅞ inch up from the bottom of your flooring and ⅜ inch in from edge of flooring, then measure 24 inches to the long point of the end from bottom and 16 inches to short point of end and place top strip at these points. Having nailed the flooring to the strips, cut the flooring along the top edge of the top strip, forming the slope of the roof. Then cut the top strip back ⅞ inch on each end from the edge of the flooring. With compasses describe a circle as shown in the figure, and with brace and bit and compass-saw cut out the circle described. On the inside of the coop nail a piece of wire screen over this hole with wire staples.

To build the front section, cut from the 1 by 2 inch strips two pieces $28\frac{1}{4}$ inches and three pieces 15 inches long. Cut enough pieces of flooring 15 inches long to cover 18 inches. Cut a piece of wire netting 10 by 30 inches and nail to nailing strip. Then nail flooring and slats to nailing strips as illustrated, keeping top nailer $\frac{1}{2}$ inch

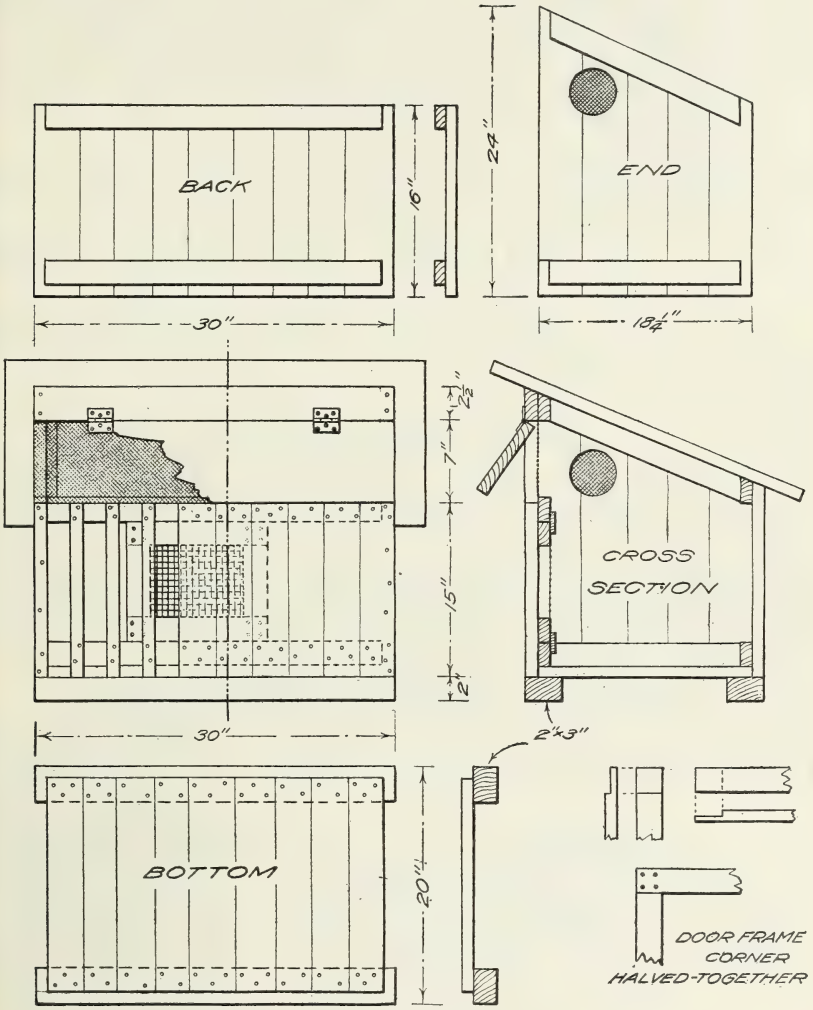


Fig. 35.—Brood coop.

above flooring and bottom nailer $\frac{7}{8}$ inch above bottom of flooring. Next, make sliding door $\frac{1}{2}$ inch smaller than distance between nailers and 17 inches long. Do this by fastening together with screws four 1 by 2 inch strips of proper lengths halved together at the angles, as shown in the illustration. Tack piece of wire netting 9 by 15 inches to this frame, and the door is ready to place with wire cloth on inside

of coop, between the nailing strips. To hold this door in between the slides, nail a piece of ½ by 2 inch stop to top and bottom nailers as shown. If you haven't a piece of this stop, a lath, a piece of beveled siding, or a strip of tin or galvanized iron may be used.

Assemble the sections thus far completed. To do this place the back and one end in position on the bottom and nail the back to the end. Then place the other end in position and nail the back to it as you did at the other end. Next, put the front in position and nail to both ends. *Do not nail back ends or front to the bottom;* the coop is to be lifted from the bottom to clean it.

Finish up the front by nailing a piece of 1 by 2 inch across the top between the ends, and tack the piece of wire netting to it. Cut 30 inches from the piece of 1 by 3 inches by 3 feet and 30 inches from the piece of 1 by 7 inches by 3 feet, hinge the two together with the 2 by 2 inch butts, and nail the 1 by 3 inch into place across the top.

The coop is now ready for a roof. Cut enough pieces of flooring 4 inches longer than slope of end of coop to cover 34 inches and nail them to front and back.

EXERCISE XVI. POULTRY HOUSE.

To carry on a home project in poultry some type of poultry house is necessary. Often boys of the rural schools will desire to construct houses. Plans, specifications, and bills of material for good types are given in Farmers' Bulletin 574. Pupils desiring to build poultry houses should write to the United States Department of Agriculture for a copy of this bulletin and follow the plans given.

EXERCISE XVII. WOODEN TROUGHS FOR SWINE.

In figures 36 and 37 are shown two types of wooden troughs that are used extensively by swine raisers. The one shown in figure 36 is designed for use in feeding young pigs. As shown in the drawing it is shallow and is constructed with a flat bottom and wide end pieces. The shallowness makes it easy for the young pigs to get at the feed, and the wide ends make it difficult for the pigs to overturn it. The cross pieces prevent the hogs from lying in the trough. The drawing gives all necessary dimensions. Make out a bill of material and a bill of stock, cut the pieces, and assemble them.

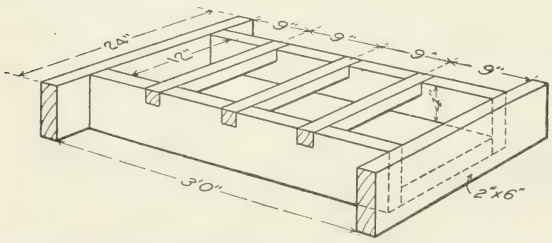


FIG. 36.—Trough for young pigs.

Figure 37 shows a V-shaped trough for older hogs. Like the one shown for young pigs, it is wide at the ends and provided with cross pieces. The drawing gives all necessary dimensions. Make out bills of material and stock, and construct.

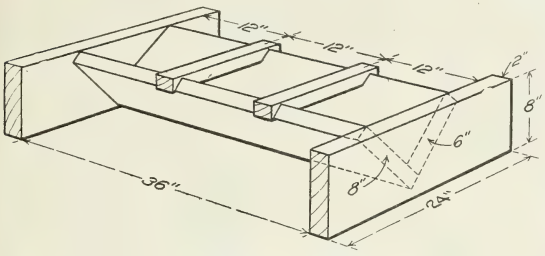


FIG. 37.—Trough for mature hogs.

NOTE TO TEACHER.—Where pig projects are a feature of school work the boys will be interested in building troughs such as are described in this exercise. This exercise and some of those that follow will fit well with the class instruction dealing with swine raising as well as with the club work.

EXERCISE XVIII. HURDLES FOR USE IN STOCK JUDGING.

A hurdle as described in this exercise is a panel of boards made as shown in figure 38. Hurdles are portable and are useful when sorting hogs or sheep into groups or keeping the animals, especially hogs, separated when scoring and judging them. Three or four hurdles fastened together at the ends make a very good temporary pen.

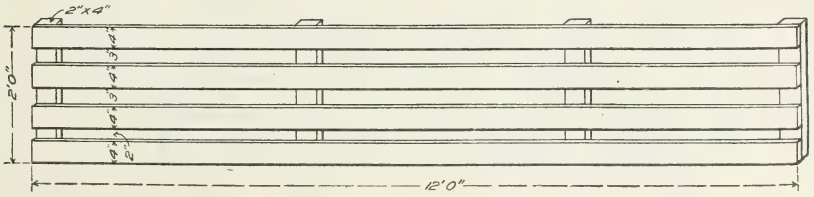


FIG. 38.—Hurdle.

The materials required are four pieces 1 by 4 inches by 12 feet, one piece 2 by 4 inches by 8 feet, and 2 pounds of eightpenny common nails. To build the panel, cut the pieces as shown in the drawing. Lay the four pieces of 2 by 4 inches on the floor, spacing them 4 feet apart, nail the bottom board, space 2 inches and nail the second board, space 3 inches and nail the third board, nail the fourth board on the top.

EXERCISE XIX. HOG HOUSES.

The members of pig projects will need some kind of hog house. Farmers' Bulletin 438, entitled "Hog Houses," gives some very practical plans for houses, and those desiring to use this exercise should send for a copy of this bulletin and follow the directions given.

EXERCISE XX. MILKING STOOL.

A very substantial milking stool is illustrated in figure 39 and described in this exercise. The material required is one piece of white pine 1 by 8 by 21 inches, one piece 2 by 4 by 14 inches, a few

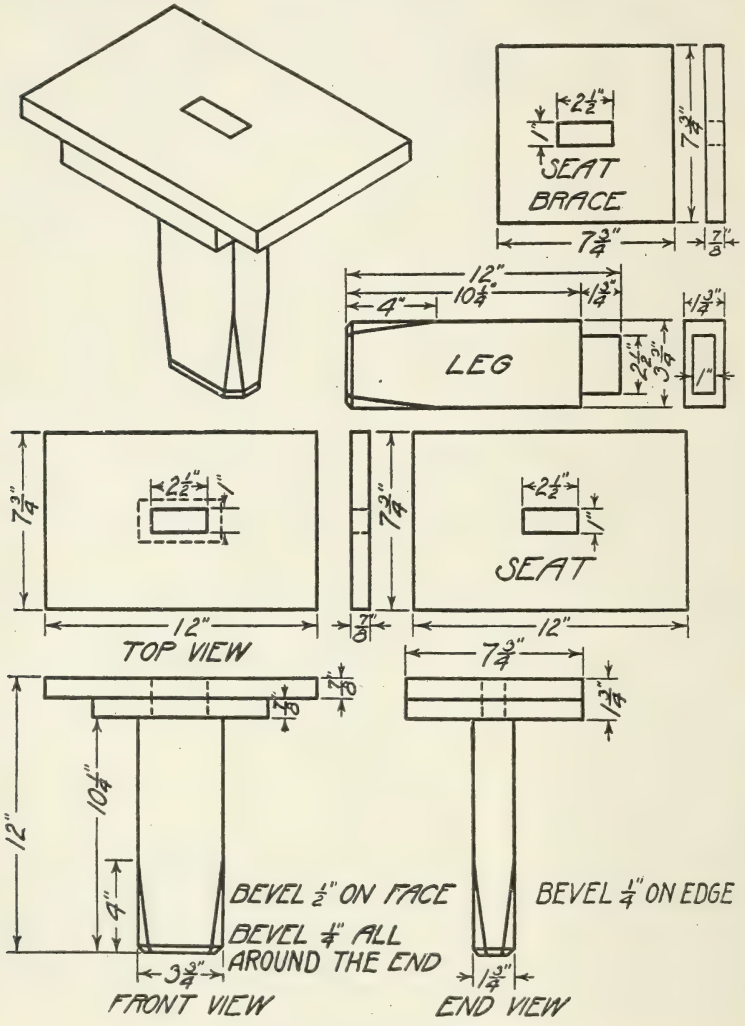


FIG. 39.—Milking stool.

8-penny nails, and a hardwood wedge. The bill of stock with finished dimensions and the use of the parts are as follows:

Use.	Number of pieces.	Finished dimensions.
		Inches.
Seat	1	7/8 by 7 3/4 by 12.
Seat brace	1	7/8 by 7 3/4 by 7 1/4.
Leg	1	1 3/4 by 3 3/4 by 12.

Cut the seat and seat brace from the 21-inch board and square up the pieces to the dimensions given in the bill of stock. Place the seat brace in position on the bottom of the seat, having the grain of the seat brace crosswise of the grain of the seat. Nail the two pieces together, driving the nails from the top and clinching them on the bottom of the brace piece. Lay out the mortise on both sides of the two pieces, as shown in the drawing. Bore three holes with a ¾-inch bit inside of the lines and trim to these lines with a ¾-inch chisel.

Cut the leg from the piece of 2 by 4 inch, squaring it up to dimensions and beveling it as shown in the drawing. Lay out the tenon on the end as called for in the drawing. Saw to the lines and trim the tenon smooth with a ¾-inch chisel. See that it will fit snugly into the mortise of the seat. Saw a slot in the tenon for a wedge. This should be made lengthwise and through the center of the tenon.

To assemble the leg and seat, slip the tenon into the mortise and drive a small hardwood wedge into the slot of the tenon. This will hold the leg and seat together firmly.

Bore a ¾-inch hole in the leg near the end to provide a means for hanging up the stool when it is not in use.

EXERCISE XXI. CALF STANCHIONS.

When calves run together in a pasture or feed lot, a row of stanchions should be provided in order that each calf may be held until it gets the proper quantity of feed and to prevent it from sucking the next one's ears. Figure 40 illustrates this exercise and describes a practical row of stanchions for this purpose. White pine, spruce, or hemlock may be used. The bill of material is as follows:

Quantity.	Dimensions.	Quantity.	Dimensions.
1 piece	1 by 5 inches by 12 feet.	1 piece	1 by 8 inches by 12 feet.
1 piece	1 by 4 inches by 12 feet.	3 bolts	⅜ by 3½ inches.
1 piece	1¼ by 4 inches by 12 feet.	3 pair light strap hinges.	
1 piece	1¼ by 4 inches by 10 feet.	2 pounds eightpenny common nails.	
1 piece	1¼ by 5 inches by 7 feet.		

From the piece of 1¼ by 5 inches by 7 feet cut two pieces 3 feet 6 inches long, and from both the 1 by 5 inches by 12 feet and 1 by 4 inches by 12 feet cut two pieces 6 feet long. Then nail the ends of the 1 by 4 inch by 6 foot pieces to the top of the 1¼ by 5 inch by 3 foot 6 inch pieces, as shown, nailing the 1 by 4 inch pieces on each side of the upright. Nail the two pieces of 1 by 5 inches by 6 feet in the same way, 18 inches below the top board.

From the 1¼ by 4 inches by 10 feet and 1¼ by 4 inches by 12 feet cut the stanchion boards, as shown. Nail a piece of 1¼ by 4 inch

between the top and bottom rails as shown, leaving a 2-inch space between the corner upright and this piece. Next, space 4 inches from this bar to the swinging bar, drop the bar in place between the rails, and with a brace and ½-inch bit bore a hole through the center of the 5-inch rail and 4-inch bar and insert one of the 3-inch bolts. Space again 4 inches from the bar and nail in the next bar. Proceed in this way with the remaining stanchions, then nail the two pieces of 1 by 8 inch by 6 foot to the back of the two end uprights, as shown.

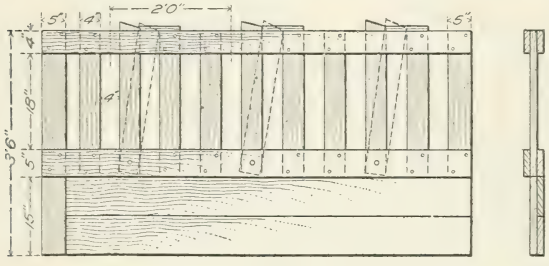


FIG. 40.—Calf stanchion.

To hold the swinging bars in place, screw one side of the light hinge to short blocks of the 1¼ by 4 inch pieces and fasten the hinges to the top of the bar to the right of the swinging bar in such a way that when the swinging bar is in closed position this block will drop in place and hold the bar.

NOTE TO TEACHER.—This exercise will fit into instruction in either dairying or beef raising. Boys who feed calves at home will be especially interested in these stanchions.

EXERCISE XXII. FARM GATE.

In figure 41 is shown a very good type of farm gate. The constructing of such a gate is not especially difficult and makes a very good exercise in farm mechanics for farm boys.

For a gate 12 feet long the material required is:

1 piece 1 by 4 inches by 14 feet.
7 pieces 1 by 4 inches by 12 feet. (White pine or other dressed lumber.)
1 pair bolt and eye gate hinges with bolts.
3 pounds 8-penny common nails or 5 pounds ¼ by 2 inch bolts.

From the piece of 1 by 4 inches by 14 feet cut two pieces of 4 feet 2 inches long. Space the boards as shown in the illustration, placing the two upright pieces 12 feet apart from outside to outside. First, nail six of the 1 by 4 inch by 12 foot boards to the strips. Next, nail the remaining 1 by 4 inch by 12 foot piece as a diagonal brace. Be sure to have this brace run to the bottom hinge end of the gate. From what is left of the 1 by 4 inch by 14 foot piece cut the two short braces as shown, and nail the diagonal and short braces to each board.

Bolts may be used instead of nails to fasten the boards together. They are a better construction, but somewhat more expensive.

To adjust the hinges, bore a hole through the gate post, insert the bolt member of the hinge, and fasten it to the post by screwing a nut on the opposite side of the post. Having fastened the bolt to the post, place the eye member of the hinge on the bolt and determine how much space is required between post and gate. This is usually about 3 inches. Allow 1 inch more for play between the gate and the opposite post if the gate is to swing clear, both ways, between posts. Thus, for a 12-foot gate the posts should be 12 feet 4 inches apart. Screw the eye members in place, and the gate is ready to hang.

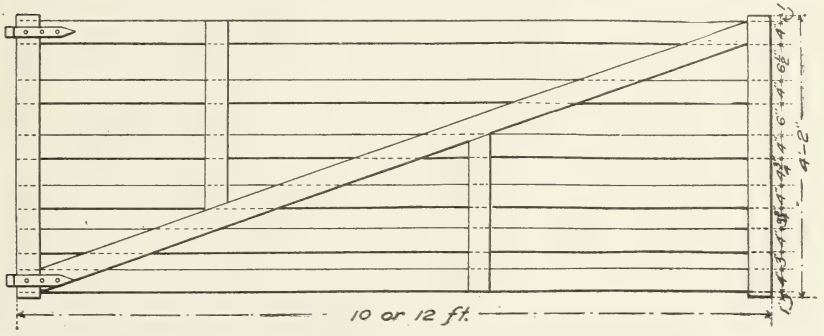


FIG. 41.—Farm gate.

EXERCISE XXIII. ROPE WORK.

The whipping and crowning of rope and the tying of various knots and hitches provide practical work for pupils in the seventh and eighth grades. Rope-tying contests will add interest to a Friday-afternoon program. Bulletins issued by the extension service of the agricultural colleges of some States have described and illustrated this rope work thoroughly. In other States, where these bulletins are not available, teachers will find the manual of the Boy Scouts of America very helpful. The boy scout is required to learn to tie knots and is examined as to his proficiency in this in much the same way as might be done at school.

EXERCISE XXIV. CONCRETE WORK.

Concrete work, such as the making of posts, floors, and sidewalks, is a type of farm mechanics that appeals to farm boys. In many cases teachers can have the boys build a fence or a sidewalk for the school grounds. Usually the shovels, trowels, and other tools necessary will be brought from home by some of the pupils. Many boys who have practice in concrete work at school will continue the work at home. Instructions for working this exercise are found in three Farmers' Bulletins, and these should be requested from the

United States Department of Agriculture and the directions followed. No. 461 gives instructions for mixing and placing concrete; No. 403 tells how to make concrete fence posts; and No. 481 tells how to lay a concrete feeding floor. A sidewalk is laid in a similar manner.

EXERCISE XXV. THE PAINTING OF WOODWORK.

Some of the articles made in the exercise will need to be painted. For information regarding the mixing and handling of paint, see Farmers' Bulletin 474. Write to the United States Department of Agriculture for a copy of this bulletin and follow the directions given.

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